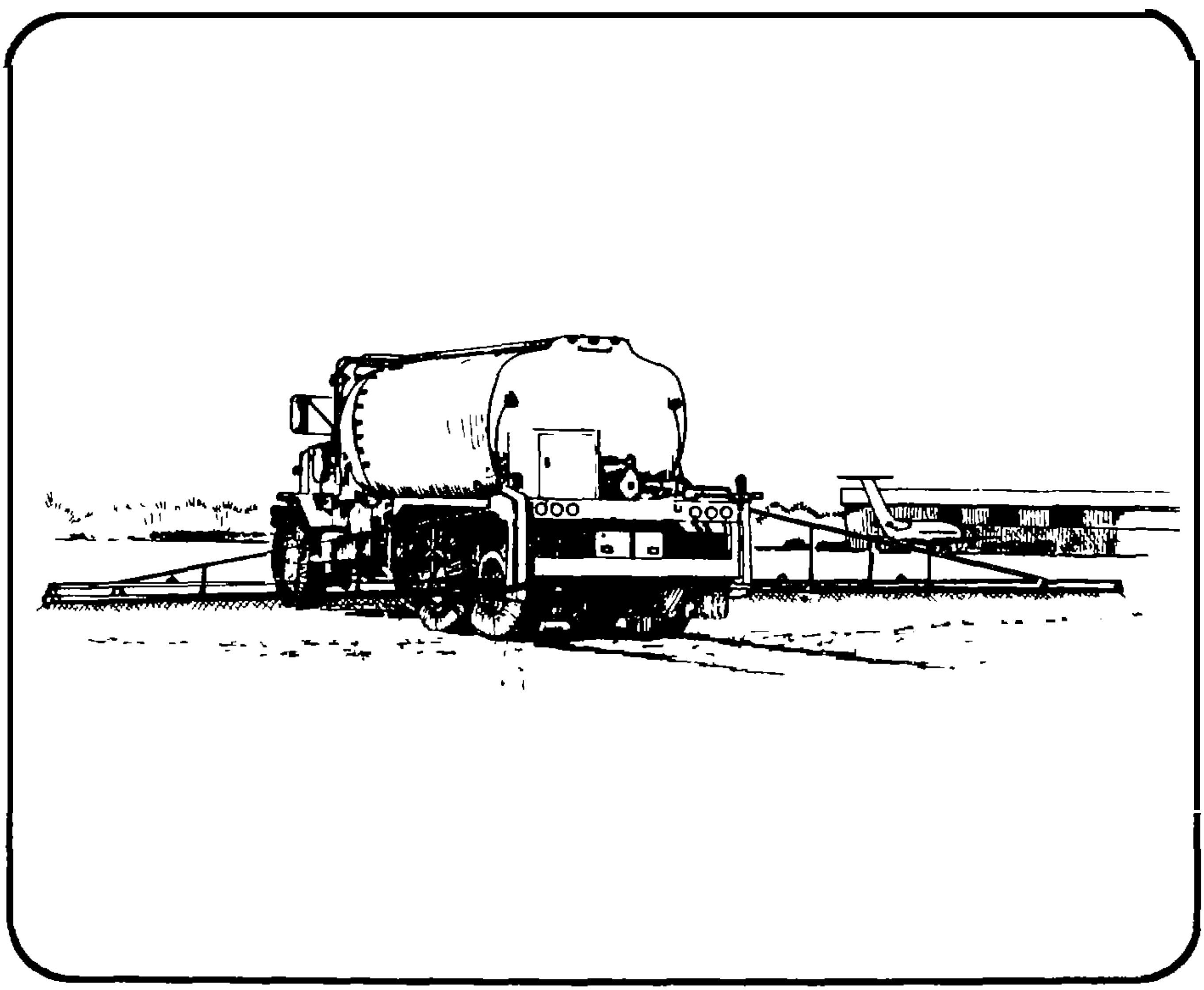
Chapter 3
Snow and Ice Removal Procedures



CHAPTER 3. SNOW AND ICE REMOVAL PROCEDURES

21 SNOW CONTROL PROCEDURES Close coordination should be maintained between the snow control center, air traffic control facility, FSS or UNICOM, and airport management to ensure a prompt response to snow and ice control urgencies Alternate access to the runway by snow and ice control equipment, friction measuring equipment, and aircraft is necessary to keep movement areas operattonal to the extent practical

a **Control of Snow Drifting** Preventing drifting snow from reaching operattonal areas will reduce the clearance effort

(1) Operational **Procedures** If possible, move the snow to the prevailing downwind side of the runway to reduce drifting Plan on the prevailing winds and the likelihood that they will change with frontal passage Another aid to help reduce drifting snow early m the season is to have all vegetation on the pavement edges mowed as short as possible

(2) **Snow Fences** Snow fences, if properly designed and located, can reduce the drifting of windblown snow Snow fences should not be placed so that they penetrate any critical surfaces, and they should be outside of the runway safety area Studies with snow fences have shown that optimum retention is obtained with a fence having 50 percent porosity, and the fence should be located upwind of the area to be protected a distance of at least thirty times the height of the fence Studies by the United States Department of Agriculture, Forest Service aided in the development of the "Wyoming" snow fence which has proven very effective It has horizontal slats with 50 percent porosity, a gap of 12-18 inches (30-46 cm) at the bottom, an angle of 15 degrees toward the leeward side, and is set perpendicular to the prevailing wind A 12-foot (37 m) height was generally most effective in their studies, though a shorter height can be used and is usually necessary on airports

(3) **Snow Trenches** An expedient involves cutting a trench in the snow which has been cleared off the edges of the runway to act as a trap (see figure 3-l) Care must be taken in digging the trenches to ensure that the surface of the safety area is not damaged (i e, ruts, humps, or bumps are created) Multiple trenches spaced about 10 feet (3 m) apart can store more snow The closest to the runway that a trench should be excavated is 50 feet (15 m)

b **Snow Removal Principles** While conditions at individual airports vary widely and may require special removal methods or techniques, there is general criteria that should be followed as closely as possible In general, airport users should be promptly notified, and a NOTAM should be issued immediately, advising of unusual airport conditions

(1) Start snow and ice control operations on priority 1 areas as defined in paragraph 16, beginning with the primary instrument runway or active runway, as soon as snow or frozen precipitation begins to fall Sweepers, if available, should be used to keep the center bare As soon as snow has accumulated to a depth that cannot efficiently be handled by the sweepers, displacement plows and rotary plows should be dispatched to remove the windrows If the pavement is warm enough for snow to compact and bond or if freezing ram is forecast, anti-icing chemicals should be applied prior to the start of precipitation or as soon after its start as possible When snow has melted or begms to accumulate, or any ice that has formed has been disbonded from the pavement by the chemical, sweepers should remove this residue

(2) The severity of a snowstorm will determine the extent of the area to be cleared initially The objective should be to clear the entire priority 1 area, but should snowfall be too heavy to accomplish this, operations should be reduced to keeping the center of the priority 1 runway and its taxiways open If the full width of the runway cannot be cleared, this situation should be reported In a NOTAM giving details of the cleared width to allow each operator to judge the suitability of conducting operations since aircraft requirements differ If this width will not meet minimum operattonal requirements, operations should be reduced further or curtailed, and efforts should be concentrated on satisfying those requirements

(3) Clearance of snow from the runway is accomplished most effectively by operating a plow team in echelon, figures 3-2 and 3-3, using a number of displacement plows to move the snow with a minimum of rehandling into a windrow which can then be cast beyond the edge lights by a rotary plow

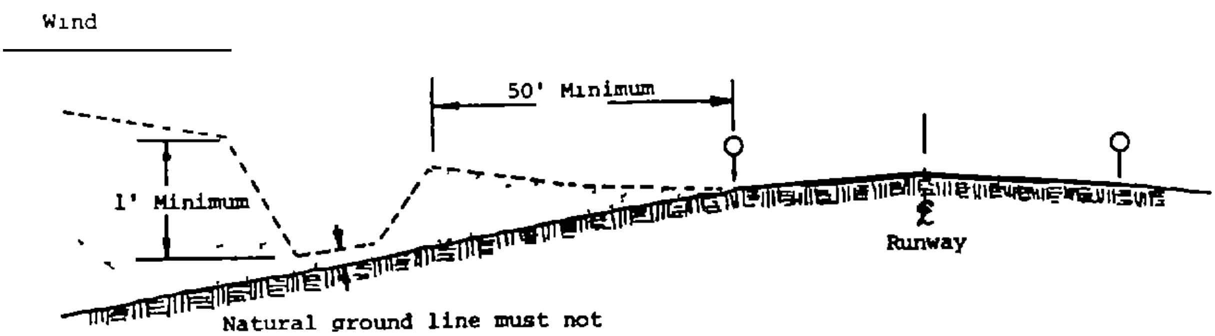


Figure 3-1. Typical Snow Trench.

The number of displacement plows to be used should be based on the volume of snow handled and the capacity of the rotary plow Blades should not be dropped onto the pavement until the equipment is in motion in order to avoid damage to pavement and equipment. A safe distance should be maintained between vehicles operating in a team to avoid accidents resulting from loss of visibility If visibility suddenly drops to near zero while plowing operations are in progress, equipment should slop immediately and radio its position to the supervisor or snow desk. No further movement should be altempted until visibility improves.

(4) If no wind is blowing, snow can be cleared to either side of the runway Selection of casting direction can then be. based on storage capacity of the field adjacent to the runway; visibility considerations, avoidance of structures, NAVAID's or other devices, and least effort clearance If a wind is blowing, however, free choice of clearance direction may not be possible because movement of snow into the wind will result in considerable drifting back onto the cleared areas and will reduce the operator's visibility In the case of a cross wind, clearance is best accomplished by plowing and casting with the wind, figure 3-4, regardless of the. situation on the side of the runway where the snow will be deposited (except make sure clearances are in tolerance with figures 3-5, 3-6a, and 3-6b)

(5) Equipment movements must he carefully timed and coordinated to ensure an orderly turnaround and safe reentry at the start of the return pass. Close liaison most be maintained between the control tower, snow control center, and supervisory personnel The control tower should be in contact with the snow control monitoring network whenever equipment is operating on movement areas

(6) The height of a snowbank on an area adjacent to a runway, taxiway, or apron should lx reduced to provide wing overhang clearance and preclude operational problems caused by ingestion of ice into turbine engines or propellers striking the banks prior to the area being reopened to aircraft operations. Figure 3-5 show the desired maximum snow height profile which generally should be obtained. This profile should be checked for the most demanding airplanes used at the airport to ensure that props, wing tips, etc, do not touch the snow with a wheel at the edge of the full-strength pavement. When conditions permit, the profile height should he reduced to facilitate future removal operations and to reduce the possibility of snow ingestion into jet engines Figures 3-6a and 3-6b provides a graphic presentation of the glide slope (ground plane) area to be kept clear Snowbanks should not be. allowed between thin area and the runway

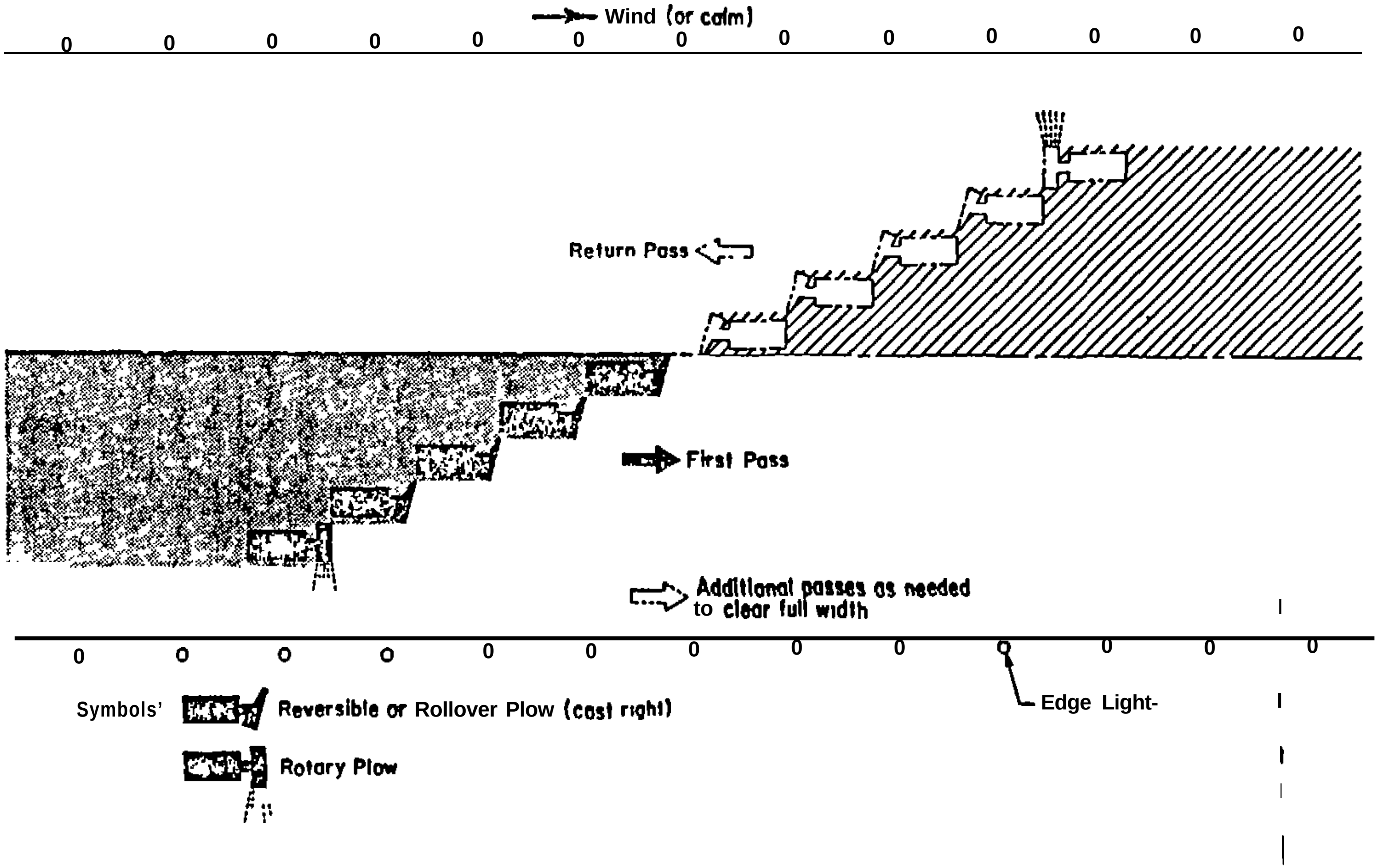


Figure 3-2 Possible Team Configuration During Light Snowfall with Parallel or Calm Wind Situations

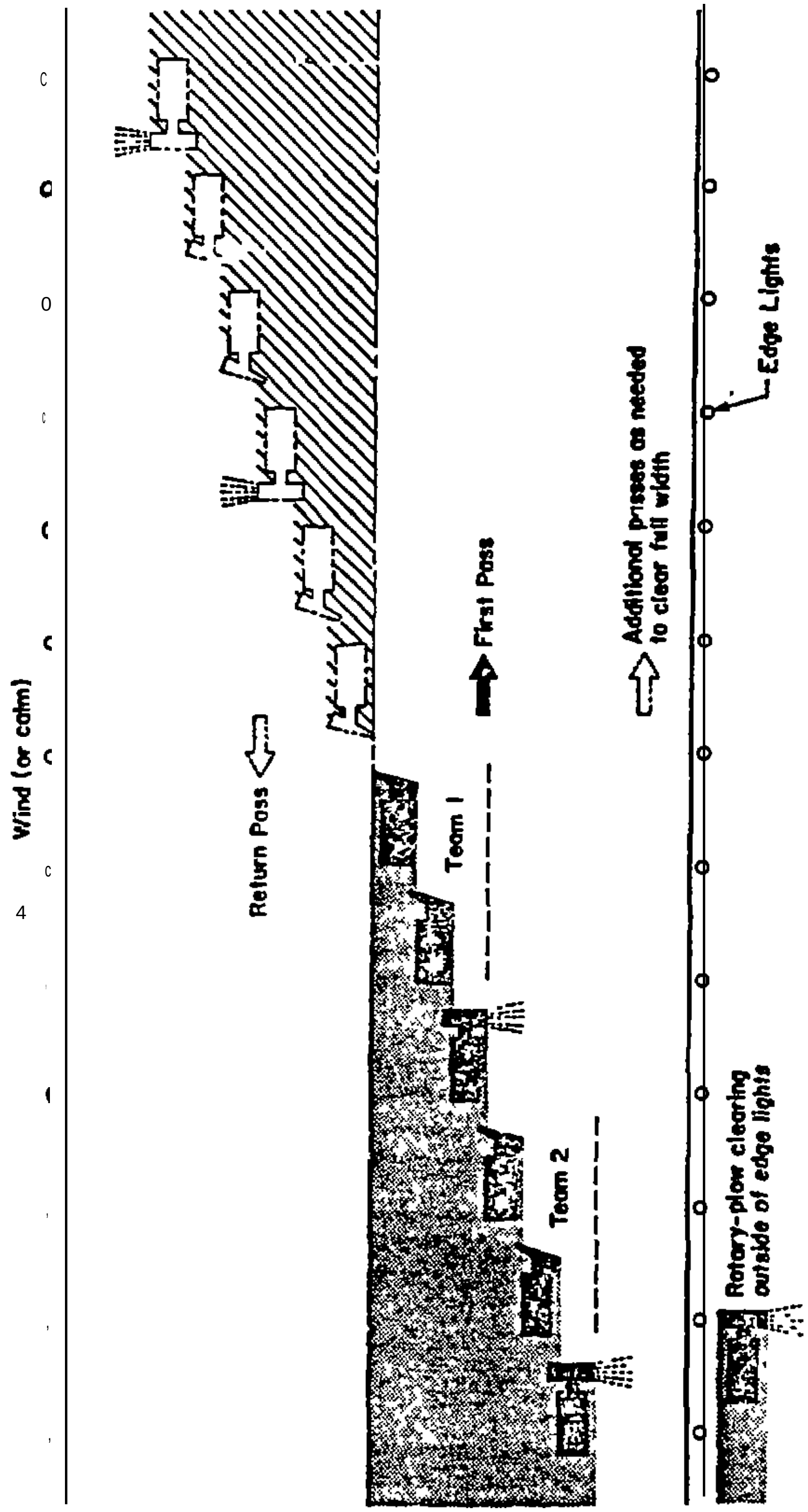


Figure 3-3 Possible **Team** ***Configuration*** **with Parrallel or** Calm wind. **Rotary** Plow Can **be Used** Outside *of* **Edge Lights** if **Suitable** Paved Shoulder is Available.

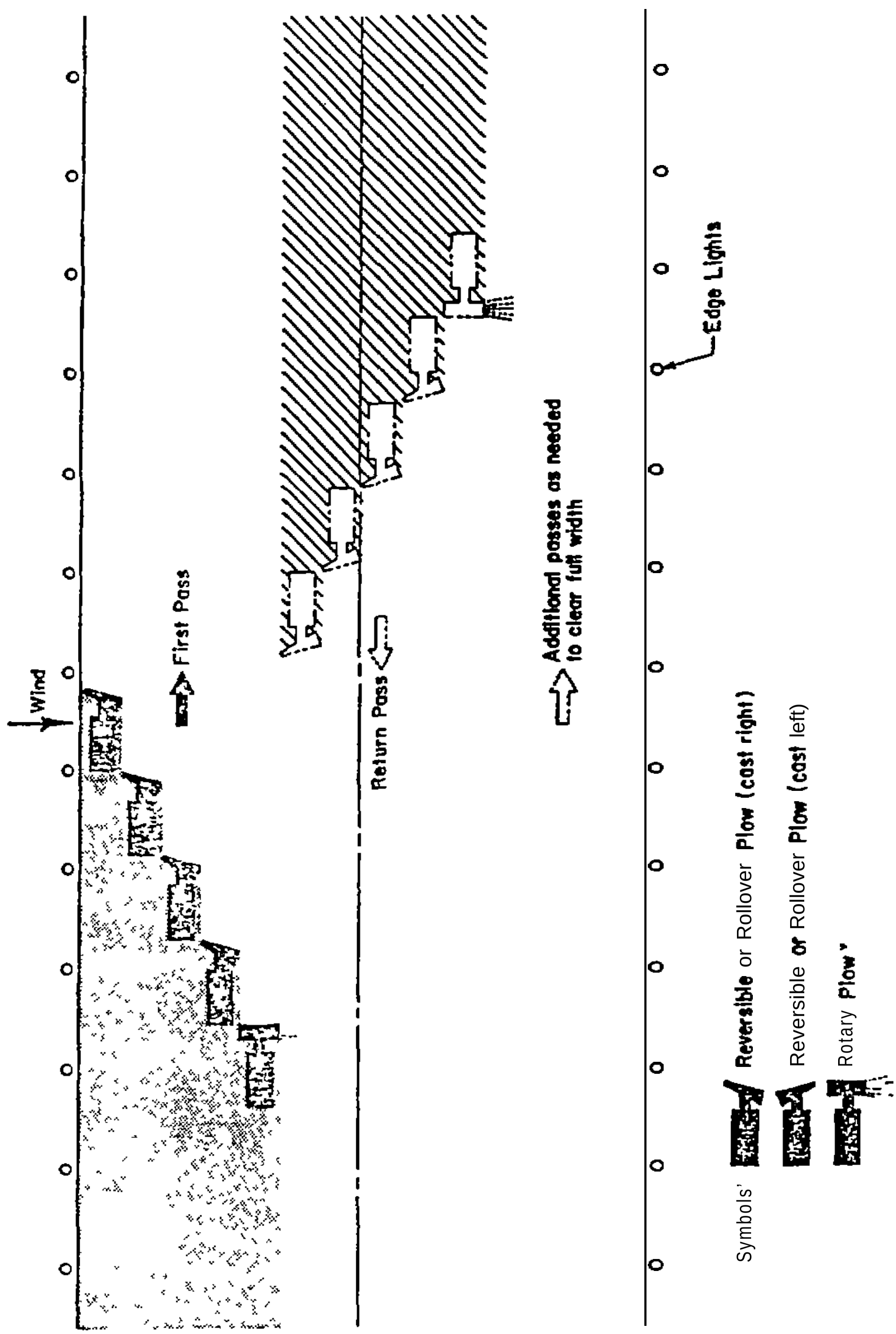
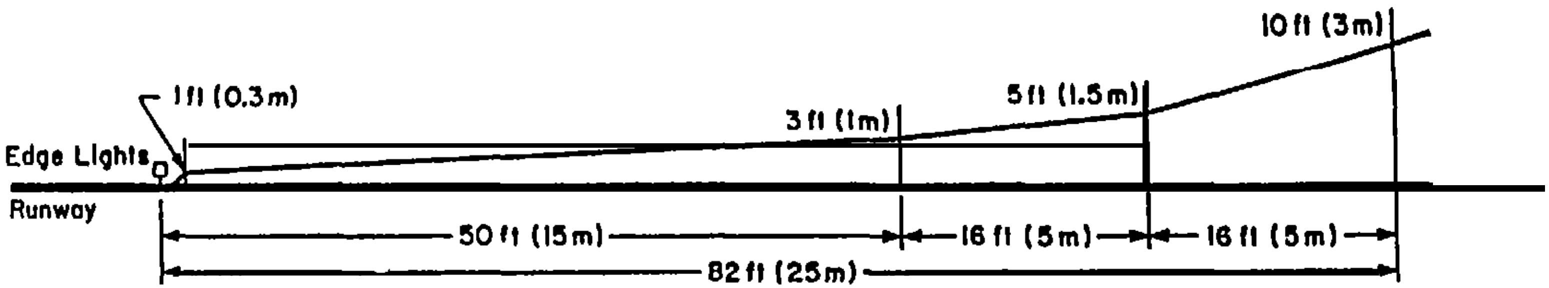
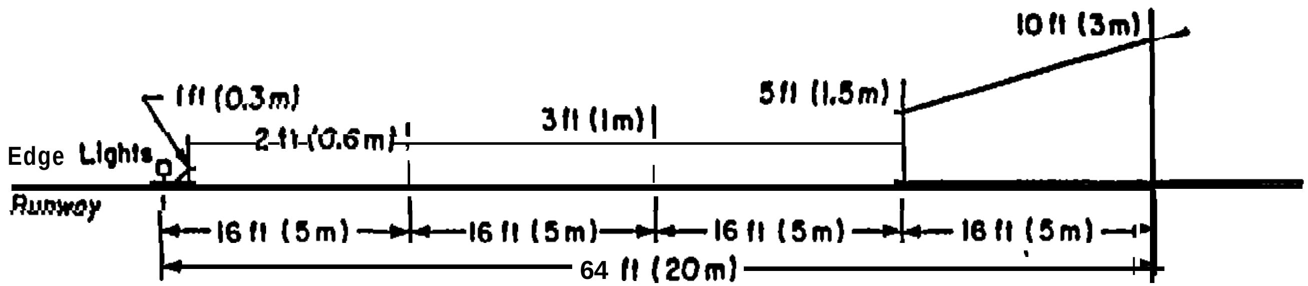


Figure 3-4 Possible Team Configuration with Perpendicular Wind
(Dependent upon Capacity of the Rotary Plow)

NOTE Snowbank heights as shown in figure 3-6a and 3-6b must also be met.



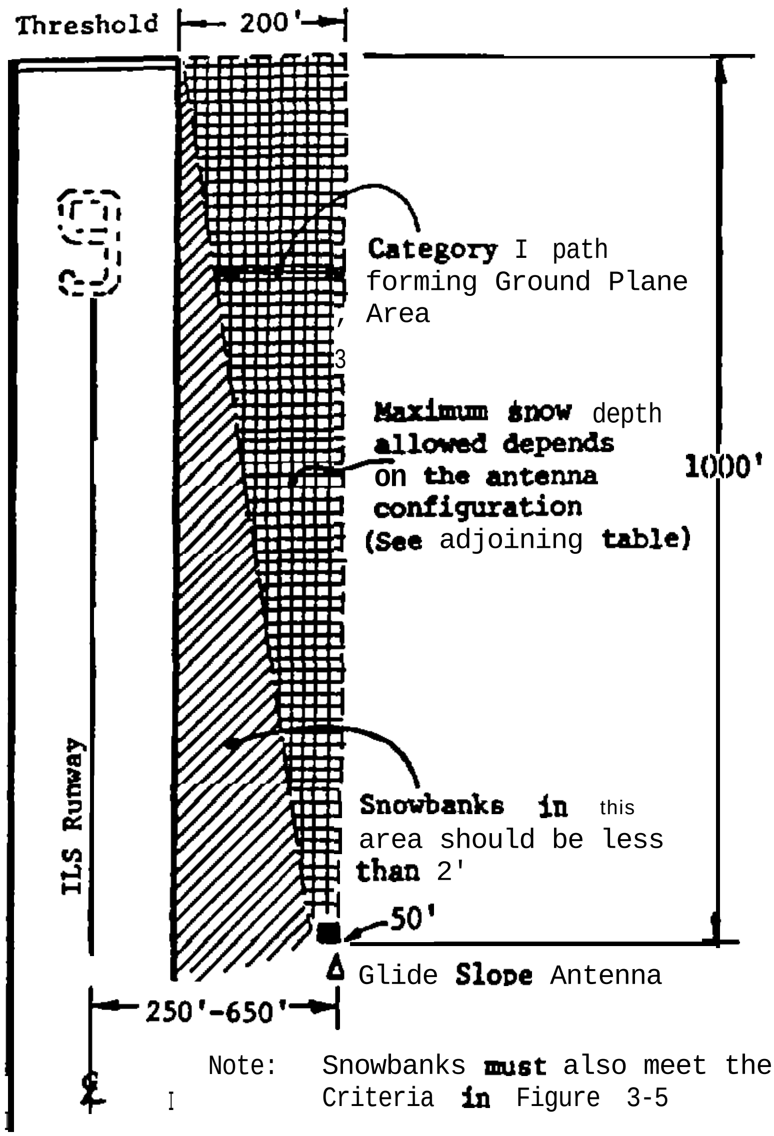
a. Runways and Taxiways Used by Airplanes in Design Groups V and VI.*



b. Runways and Taxiways Used by Airplanes in Design Groups I, II, III, and IV.*

* As defined in AC 150/5300 13

Figure 3-5 Snowbank Heights Generally Acceptable to Clear Engines and Wingtips With the Airplane Wheels on Full Strength Pavement

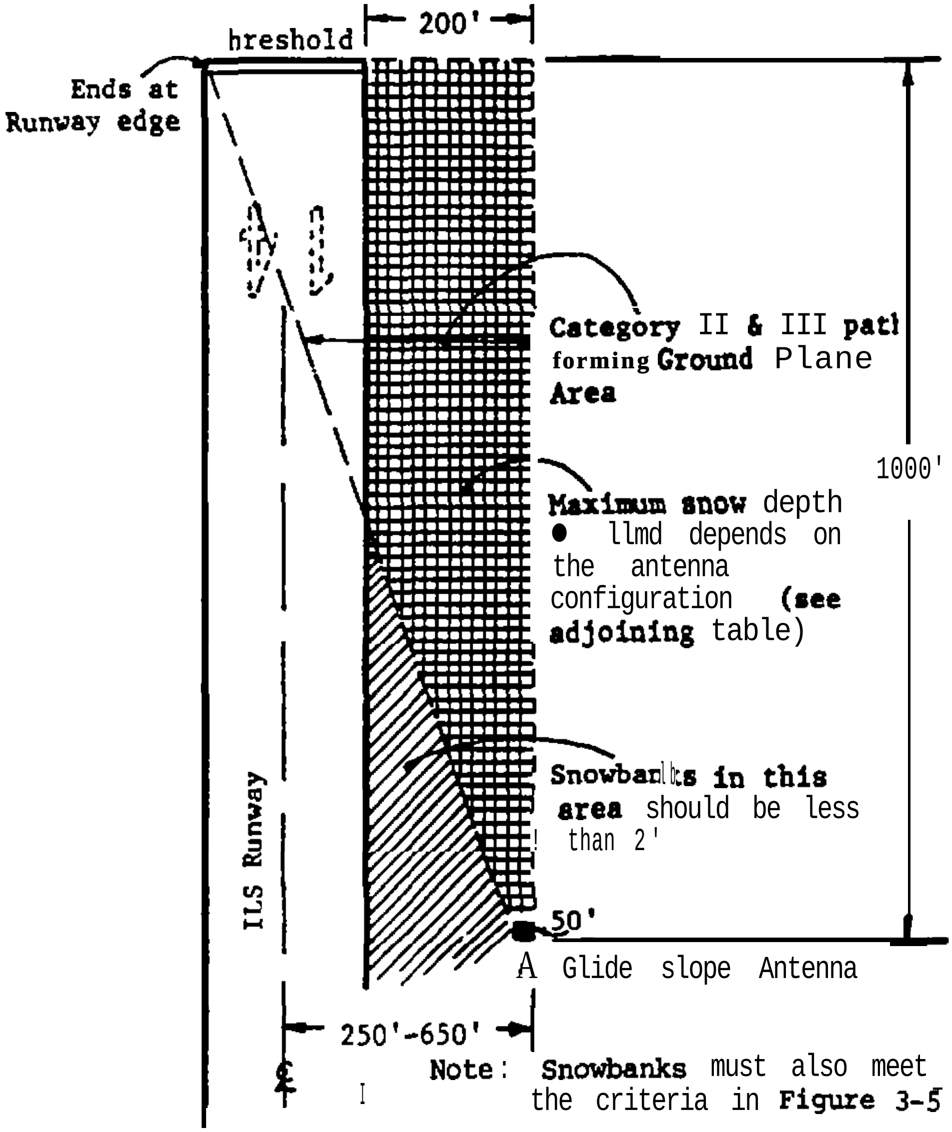


SNOW DEPTH

ACTION TAKEN	SBR < 6 in NR CEGS < 18 in	SBR 6 - 8 in NR CEGS 18 - 24 in	SBR > 8 in NR,CEGS > 24 in
Snow is removed	Removal not required Full CAT I service	Remove snow 50 ft wide at mast widening to 200 ft wide at 1000 ft towards middle marker	
Snow is not removed	Full CAT I service	Category D aircraft minima raised to localizer only	CAT I approach restricted to localizer only minima

Antenna configurations SBR sideband reference
NR null reference
CEGS capture-effect glide slope

Figure 3-6a CAT I Snow Critical Areas to be Kept Clear of Snow Accumulation



SNOW DEPTH

ACTION TAKEN	SBR < 6 in NR,CEGS < 18 in	SBR 6 - 8 in NR,CEGS 18 - 24 in	SBR > 8 in NR,CEGS > 24 in
Snow is removed	Removal not required Full CAT II & III services	Remove snow 50 ft wide at mast widening to 200 ft wide at 1000 ft towards middle marker plus widen the area to include the line from the mast to the far edge of the runway threshold	
Snow is not removed	Full CAT II & III services	Both CAT II & III restore to CAT I service Category D aircraft minima raised to localizer only	Landing minima raised to localizer only minima

Antenna configurations
SBR sideband reference
NR null reference
CEGS capture-effect glide slope

Figure 3-6b CAT II & III Snow Critical Areas to be Kept Clear of Snow Accumulation

(7) Movement areas where aircraft will operate at high speeds such as turnoffs should receive tie same snow and ice control attention as runways Areas of low speed operation such as taxiways and ramps can also be critical under some conditions Directional control and braking action should be maintained under all conditions

(8) Airports with p m t military operations may have arresting barriers located near tbe end of tbe active runway or the beginning of the overrun area Great care should be taken in clearing snow from tbe barriers Barriers located on the runway should be deactivated and pendants removed prior to snow removal operations Snow should be removed to tbe distance required for effective runout of tbe arresting system snow removal involving arresting barriers should be coordinated with the military tenant prior to the snow removal season

(9) The faces of all signs and all lights should be kept clear of snow and in good repair at all tunes Priority should be given to lights and signs associated with bold lines and ILS critical areas Time and effort in clearing snow from around the lights may be minimized by plowmg as close as possible to them It is also recommended that the rem-g snow be blown away using a truck-mounted airblast unit, the airblast firm a broom, or by spraying with a liquid deicing chemical As a last resort, hand shoveling may be necessary

(10) Centerline and touchdown zone (TDZ) lights inset in the pavement tend to form "igloos" of ice or compacted snow surrounding them Heat from the lamps will melt even cold dry mow which will refreeze and adhere to the pavement and then accumulate around the lights One method of control or removal is described in paragraph 24 To prevent damage to these lights, use rubber or plastic cuttmg edges or shoes and casters on plow moldboards and tbe front of rotary plows

(11) Striated pavement markings are useful in reducing ice buildup

22 SNOW DISPOSAL. Some means of disposing of snow most be provided when there is insufficient space for storage adjacent to cleared areas This will entail loading bucks and hauling to a disposal site, pushing the snow into meltmg pas sited near tbe areas being cleared, or portable melting pits set up over catch basins Although meltmg pits eliminate long hauls and may reduce truck traffic in the ramp area, an economic analysis should be made to determine the benefit of constructing and operating them Calculation of tbe thermal energy required is based on the heat of fusion of ice, 144 Btu/lb (335 kJ/kg) and the specific heat of ice, 0 5 Btu/lb (2 1 kJ/kg) Submerged combustion burners have been developed and are commercially available A typical 10 x 8 x 8 ft (3 x 2 4 x 2 4 m) deep melting pit containing two burners can melt 120 tons of snow per hour (30 kg/s) consuming 60 gal (227 liters) of No 2 fuel oil per burner

2 3 MECHANICAL METHODS FOR CONTROLLING ICE Ice near the freezing point is soft and may be scraped off the pavement Cold, hard ice bonds much more tenaciously and is difficult to remove by mechanical means Scraping is not very effective, and attempts to lift the ice from tbe pavement by penetration with a wedge parallel to the pavement, have only been partially successful Cutting edges attached to plow moldboards can be operated in contact with the pavement in the attempt to remove ice At plowing speeds above about 10 mph (16 km/hr), front-mounted plows tend to bounce and leave ice on the pavement Slower speeds, heavier plows, or plows which can be downloaded cm reduce this "porpoising" or bouncing Application of downward force also helps to penetrate and scrape the ice Although down pressure can be applied by hydraulic cylinders on front-mounted plows, underbody blades can apply greater pressure without reducing steering control All blades or cuttmg edges or the moldboards to which they are attached should have trip mechanisms to release the blade upon striking an obstacle m order to prevent damage to the blade, truck, pavement insert, or pavement Carbon steel cuttmg edges run in contact with the pavement wear rapidly and require frequent replacement Tungsten carbide cutting edges are extremely tough and can last for thousands of miles They are brittle, however, and can chip upon striking metal or other very bard projections Serrated cuttmg edges which cut grooves in bard ice are sometimes used and will facilitate retention of chemicals and abrasives which might otherwise be blown off. Centerline or flush lights should not be plowed with metal cuttmg edges contacting the pavement, rubber or polymer cutting edges wffl help prevent damage to tbe lights Slush or very soft ice can also be removed effectively by rubber cutting edges which squeegee the pavement

24 ANTI-ICING VS DEICING The most difficult task in winter maintenance occurs when snow or ice bond to the pavement Thus tbe primary effort sbwld be directed at bond prevention Though dry snow will not readily form a strong bond even under heavy and frequent wheel passes, wet snow and ice will develop such a strong bond that mechanical removal is either

difficult, slow, or damaging to the pavement Ice removal after formation is called deicing, preventing the bond from forming is called anti-icing or bond prevention Anti-icing, which is recommended over deicing whenever possible, is accomplished by concentrating either thermal or chemical energy at the pavement surface Because of me high cost of installing pavement heating systems and the large amounts of energy required to maintain the surface above freezing prior to the onset of precipitation, anti-icing/deicing with approved airside chemicals is generally more economical Chemical application is in either solid (includes pre-wetted) or liquid form Chemicals m liquid form are most effective for uniform anti-icing treatment of pavements All deicing/anti- icing chemicals should be applied based on pavement temperature rather than air temperature (see AC 150/5220-13A, Runway Surface Condition Sensor-Specification Guide)

a **Deicing Chemicals** Deicing chemicals should be applied on ice 1/16 inch (15 mm) or less in thickness Thicker layers of ice require an extended period of time to obtain ice-free pavement However, solar radiation from even a cloudy sky enhances melting action to such an extent that elimination of ice thickness greater than 1/16 inch (1 5 mm) are possible

b **Anti-icing Chemicals.** The recommended chemical form for anti-icing is liquid, although solid chemicals can also be effective in this application A dry solid chemical has the disadvantages that if applied to a cold dry surface it may not adhere and therefore, may be windblown or scattered by aircraft movements However, certain physical properties of a solid, such as its bulk density, particle shape, etc , may reduce these tendencies Regardless, wetting a dry anti-icing chemical, either during distribution or before or after loading into the application vehicle, improves the ability to achieve uniform distribution and improved adhesion

25 CHEMICALS Any water-soluble substance will lower the freezing point of water and thus promote the melting of ice Theoretically, the lower the molecular weight and the more individual particles (ions) the substance disassociates into, the more effective the product is as an ice control chemical, assuming its solubility still remains high at the freezing temperature For the purpose of shared information, airport operators should advise the airlines before introducing a new chemical on the airside

a. **Approved Airside Chemicals.** The FAA either establishes approval specifications or, upon recognition, references the specifications of professional associations such as the Society of Automotive Engineers (SAE) through Aerospace Material Specifications (AMS) and the United States military (MIL-SPEC) The approved airside chemicals for non-aircraft applications are fluid and solid products meeting a generic SAE specification or MIL specification These specifications require vendors to provide the airport operator with a material safety data sheet (MSDS) and certification that the chemical conforms to the applicable specification With the increased accountability placed on airport operators to manage deicing/anti-icing chemical runoff, they should request vendors to provide certain environmental data These data consist of pollutants that the Environmental Protection Agency and the State Department of Natural Resources require of the airport operator in their discharge reporting Typical information includes percent product biodegradability, biochemical oxygen demand (BOD5), chemical oxygen demand (COD), pH, presence of toxic or hazardous components, if any, and remaining inert elements after application Related to the environment, MSDSs provide measures on how to secure large product spills and a 24-hour toll-free emergency phone number While these fluid and solid specifications cover technical requirements for deicing/anti-icing compounds, they do not address the compatibility issue of combining products during operations Airport operators should query manufacturers about the safe and proper use of concurrently applying multiple deicers/anti-icers The FAA-approved airside chemical specifications are as follows

Application Rate of Urea (lb/ft²) [kg/m²]

Ice thickness (in) [cm]	Temp. (F) [C] in degrees 30' [-1 1°]	25° [-3 9°]	20' [-6 7°]
less than 1/32 [08]	016 [078]	023 [0 11]	060 [0 29]
1/32 [08] up to but not including 1/8 [32]	030 [0 15]	060 [0 29]	125 [0 61]
1/8-1/4 [32- 64]	125 [0 61]	175 [0 86]	275 [1 34]

temperature value The decreasing melting rate is a result of urea's eutecttc temperature, defined in paragraph 2f, which is appronmately 113°F (-115°C) However, the presence of solar radiation assists urea in the melting action Pavement surface temperature and ice thickness determine the urea application rate

(2) **Glycol-base Fluids.** The approved specifications are SAE AMS 1426B, Fluid, Deicing/Anti-icing - Runways and Taxiways, and MIL-D-83411A, Deicer/Anti-icer Fluid (for Runways and Taxiways) Composition of proprietary solutions meeting these specifications vanes with the manufacturer, though the glycol-base content is approximately SO percent. Application rates range from 1-2 gal/1000 ft² for deicing and from 0 2-O 5 gal/1000 ft² for anti-icing While the above specifications only require a eutectic temperature of -10°F (-23°C) or less, proprietary products are available with eutecttc temperatures as low as -75°F (-59°C) Ethylene glycol has a eutecttc temperature of appronmately -58°F (-WC) for an aqueous solution of 58-78 weight percent of ethylene glycol and a freezing point of appronmately 8 6°F (-13°C) for the pure fluid. Propylene glycol has a eutectic temperature of appronmately -75°F (-59°C) for an aqueous solution of 60 weight percent of propylene glycol Propylene glycol in its pure form does not have a freezing point per se but sets to glass below -60°F (-51°C) The following are two varieties of glycol-based fluids with their corresponding chemical formula ethylene glycol $(CH_2)(OH)(CH_2)(OH)$ and propylene glycol $(CH_2)(OH)(CH)(OH)(CH_3)$

(3) **Calcium** Magnesium Acetate **(CMA)** and **Magnesium Calcium** Acetate **(MCA)** Appendix 4 contains the approved "interim specification" for these products Currently, the SAE is in the process of writing a generic solid specification which may replace the specification in appendix 4 Both products function only as pavement surface deicers/anti-icier Proprietary products are available having eutecttc temperatures lower than that specified for ethylene glycol Product application rates are provided by manufacturers

b **Landside Chemicals** The most effective landside chemicals used for deicing/anti-icing, based on both cost and freezing point depression, are from the chloride family, e g , sodium chloride (rock salt), calcium chloride, and lithium chloride Unfortunately, these chemicals are known to be corrosive to aircraft, and. therefore. are prohibited from use on aircraft operational areas However, some chemicals that are classified as salts, such as CMA, sodium for-mate, and potassium acetate, are approved for airside use because they are able to comply with the SAE specification for noncorrosive chemicals It should be noted that when any corrosive chemical is used, precautions should be taken to ensure that vehicles do not track these products onto the operational areas

26 **ENVIRONMENTAL** ASPECTS OF DEICING **CHEMICALS** All freezing point depressants may cause scaling of portland cement concrete (PCC) by physical action related to the chemical concentration gradient in the pavement Deleterious effects on PCC can be reduced by ensuring sufficient cover over reinforcing steel (minimum of 2 inches (5 cm)), using air-entraining additives, and avoiding applications of chemicals for a year after placement Concrete meeting the compressive strength outlined in ASTM C 672 or concrete receiving a prior application of commercial concrete sealer, such as boiled linseed oil, will perform very well when subjected to chemical deicers No surface degradation of asphalt concrete has been observed due to deicing chemicals Both deicing chemicals commonly used on airfields, urea and ethylene glycol, rapidly biodegrade in the environment although biological oxygen demand is high Low temperatures and dilution from heavy runoff dunng periods of use tend to minimize this Urea decomposes to ammonia which may be quickly dissipated.

27 RUNWAY **FRICTION IMPROVEMENT** Since snow and ice degrade the coefficient of friction between rubber tires and pavement and could pose an unsafe condition for aircraft, it is important to clear to bare pavement whenever possible There are situations where complete removal is difficult or

impossible to achieve within a required span of time At temperatures approaching the eutectic temperature of a deicing chemtcal, for instance, it may require an hour or more for the chenucal to go into solution and melt the ice There are two techniques for modifying the frictional coefficient of a pavement covered with ice or compacted snow one by building in a texture on the surface. and the other by surface treatment of the ice or snow It should be emphasized, however, that an abrasive is not a deicing chenucal and will not remove ice or compacted snow--in fact, heavy applications of abrasives can insulate the ice and prolong its presence

a Pavement Surface Modification Surface texture and surface treatment modifications will not individually increase the coefficient of friction of ice formed on the surface, but combined they will enhance the response of chemical treatment

(1) Pavement Grooving Grooves cut into the pavement will trap deicing chemtcal, reduce loss, and prolong its action Grooves also assist in draining melt water and avoiding its refreezing There is empirical evidence that grooves and porous friction courses modify the thermal characteristics of a pavement surface, probably by reducing the radiant heat loss and delay the formation of ice There do not appear to be any negative effects from grooved pavements

(2) Porous Friction Course (PFC) PFC has generally the same benefits as grooving Open graded asphalt concrete is less effective in improving coefficient of friction under icing conditions because the open spaces will till with compacted snow, and to a lesser extent with ice in the case of freezing rain. Most maintenance personnel have found that chemical treatment rates must be increased on this type of pavement compared to dense graded asphalt concrete because of drainage of the chemical The drainage characteristics also change as abrasives accumulate in the voids and plug them.

b Surface Treatment. This is the approach taken to rapidly increase the frictional coefficient of an ice surface Two methods are available application of coarse granular material (abrasives) and scarifying the ice surface with a serrated blade A friction value measured below 27 (MU equivalent), as discussed in paragraph 13, indicates that surface treatment should be initiated

(1) Abrasives Granular material provides a roughened surface on ice and, thereby, improves aircraft directional control and braking performance Use of abrasives should be controlled carefully on turbojet movement areas to reduce engine erosion. If the granules do not embed or adhere to the ice, not only are they likely to be ingested in engines but they can be blown away by wind or scattered by traffic action and serve no useful function This is particularly the case when ice or compacted snow is at temperatures below about 20°F (-6 7° C) since no water film exists on the surface to act as an adhesive There are three approaches to reducing loss of abrasives (a) they can be heated to enhance embedding into the cold surface, (b) the granules can be coated with a noncorrosive deicing chemtcal in the stockpile or in the distributing truck hopper, or (c) water or diluted deicing chemtcal can be sprayed on the granules or the pavement at the tune of spreading If stockpiles are kept in a heated enclosure and spread promptly after truck loading, sufficient heat may remain for embedding without the necessity for any further treatment. One method of setting the sand, though difficult to Implement, is to apply heat after the sand has been spread by using weed burners or other open flame sources Maintenance personnel should make a teat on an unused pavement covered with ice or compacted snow to determine if bonding is adequate to prevent loss When the slippery condition giving rise to the requirement for abrasives has passed, treated pavements should be swept to remove the residue and prevent engine damage Abrasives should be used when the friction measurement is below 27 (MU equivalent) Other factors to consider when deciding to apply abrasives are pavement and air temperature and frequency of operations

(2) Ice Scarifying Directional control of vehicles on an ice or compacted snow surface can be improved dramatically by cutting longitudinal grooves in the ice However, no improvement in braking effectiveness results from grooving, so this approach is only an expedient to be employed when very low temperatures prevent rapid chemtcal action or mechanical removal The grooves trap abrasives or chemicals and hence. contribute to improving the surface friction characteristics or melting action

turbojet movement areas to reduce engine erosion If the granules do not embed or adhere to the ice, not only are they likely to be ingested in engines but they can be blown away by wind or scattered by traffic action and serve no useful function. This is particularly the case when ice or compacted snow is at temperatures below about 20° F (-7° C) since no water film exists on the surface to act as an adhesive There are three approaches to reducing loss of sand (a) they can be heated to enhance embedding into the cold surface, (b) the granules can be costed with an approved deicing chemical in the stockpile or in the distributing truck hopper; or (c) dilute deicing chemical can be sprayed on the granules or the pavement at the time of spreading If stockpiles are kept in a heated enclosure and spread promptly after truck loading, sufficient heat may remain for embedding without the necessity for any further treatment One method of setting the sand, though difficult to implement, is to apply heat after the sand has been spread by using weed burners or other open flame sources Maintenance personnel should make a test on an unused pavement covered with ice or compacted snow to determine if bonding is adequate to prevent loss When me slippery condition giving rise to the requirement for sand has passed, treated pavements should be swept to remove the residue to prevent engine damage Sand should be used when the friction measurement, as discussed in paragraph 13, is below 27 (MU equivalent) Other factors to consider when deciding to apply sand are pavement and air temperatures and frequency of operations

(2) Ice Scarifying Directional control of vehicles on an ice or compacted snow surface can be improved dramatically by cutting longitudinal grooves in the ice However, no improvement in braking effectiveness results from grooving, so this approach is only an expedient to be employed when very low temperatures prevent rapid chemical action or mechanical removal The grooves trap sand or chemicals and hence contribute to improving the surface friction characteristics and melting action

28 SAND

a **Materials.** All sands do not perform the same Studies have shown, however, that virtually any sand will be adequate to Improve traction on a runway If used in sufficient quantities In general, the greater the quantity of sand applied, the greater the increase in traction Fine sands show superior performance on warmer ice (> 20°F (-7°C)), while coarser sands show superior performance on colder ice (<15°F (-9°C)) (For the purposes of this AC, sand retained on a #30 sieve is considered "coarse," and sand passing a #30 sieve is considered "fine") The type and quantity of sand used, therefore, should be based on local needs, availability and price, and required application rate based on experience While some sands may be more expensive, a lower required application rate may make such a sand the most economical choice for a particular airport. Tenant airlines should be consulted about the material used on the runways

(1) **Standard.** *The following is the minimum acceptable standard for sand* Friction improving materials applied to airport movement surfaces shall consist of washed granular mineral sand particles free of stones, clay, debris, slag, and chloride salts and other corrosive substances The pH of the water solution containing the material shall be approximately neutral (pH 7) Material shall meet the following gradation using U S A Standard Sieves conforming to ASTM E 11-81

Sieve Designation	Percent by Weight Passing
8	100
80	0-2

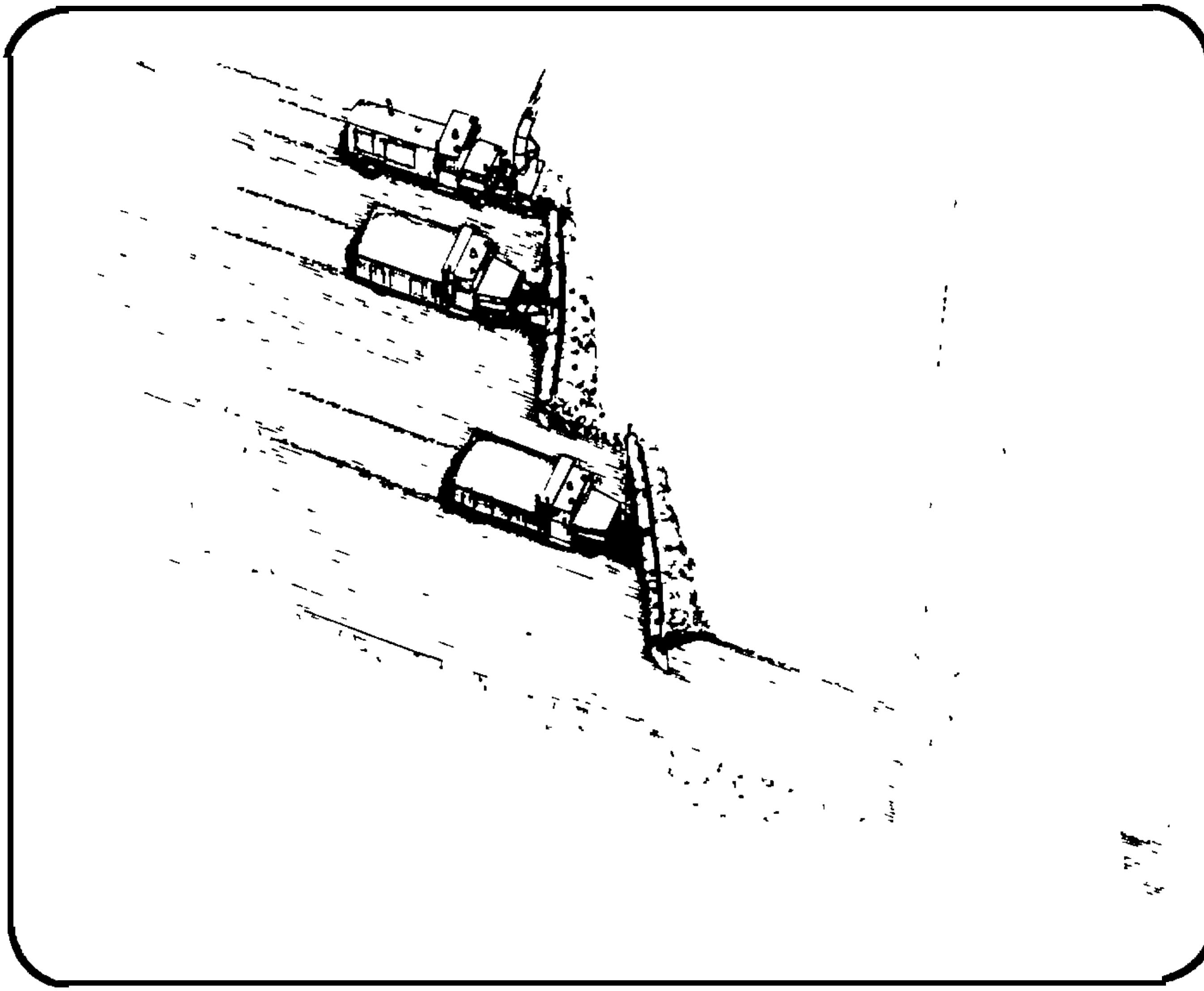
(2) Recommendation. For optimum performance on both warmer and colder ice, a gradation that balances fine and coarse particles is desireable For this reason, the inclusion of an additional sieve beyond that required by the FAA minimum standard is recommended, resulting in the following gradation

Sieve Designation	Percent by Weight Passing
8	100
30	20-50
80	0-2

b **Application.** Hard silica sand provides the greatest increase in traction and remains effective the longest when compared to softer materials because of its resistance to fracturing However, it is also very abrasive and, therefore, more potentially damaging to aircraft engines Limestone is softer and may be used where available if abrasion needs to be reduced Tests have shown that application rates of 0 02-0 1 lb/ft^2 (0 1-0 5 kg/m^2) of sand will substantially increase the runway friction coefficient. The greater amount is required at temperatures approaching 32°F (0°C), the amount decreasing as the temperature drops Fractured particles provide some advantage in traction enhancement but not enough to justify much of a difference in cost.

c. Chemically or Heat-treated Sand Granular particles may be treated with approved chemicals or heated to make them adhere to ice, thereby preventing loss of material At temperatures above 15°F (-9°C). a solution of airside urea may be used, below this temperature, glycol or potassium acetate will be more effective Approximately 8-10 gallons (30-40 liters) of fluid chemical are required to coat one ton of sand. The most effective method of applying the chemical is to spray it on granules as they drop onto the spinner mechanism of a material spreader since wetting is more thorough than pouring the chemicals onto the stockpile or the hopper load Below 0°F (-18°C), heated sand can be more effective because of more rapid adhesion of the granules to ice If the decision is made to use heated sand, a coarser mixture should be used, as fine particles cool too rapidly on dispersal before hitting the ice Sands heated to 80°F (27°C) or higher adhere well to ice

Appendicies



APPENDIX 1 - EXAMPLES OF SNOW NOTAMS

These examples illustrate snow NOTAM information rehung to conditions existing on movement areas during periods of snow and ice and actions taken to maintain operational capability See AC 150/5200-28, Notices to Airmen (NOTAMS) for Airport Operators, for greater detail

Contractions:	Meaning:
BRAF	Braking action fair
BRAG	Braking action good
BRAN	Braking action nil
BRAP	Braking action poor
CHM	Chemicals applied on runway
CLSD	Closed
FRZN	Frozen
IR	Ice on runway
IN	Inch(es)
LGT	Light, or lighted
ISR	Loose snow on runway
MAEW	Men and equipment working
Mu	A runway friction measuring ratio
OBSC	Obscured
OVR	Over
PSR	Packed snow on runway
SIR	Packed or compacted snow/ice on runway
PTCHY	Patchy
PLW	Plowed
RUF	Rough
RY	Runway
SND	Sand or sanded
SLR	Slush on runway
SNW	Snow
BERM	Snowbank contains earth/gravel (AK only)
DRFT	Snowbanks drifted by wind
SNBNK	Snowbanks, plowed
TWY	Taxiway
WSR	Wet snow on runway
###	(location identifier)

Examples

9-27 1/2 IN PTCHY SNW PLW 75 WIDE+RY LGT E 2000 OBSC

Explanation An airport's 8000 ft (24 km) runway has been plowed its entire lengtb but for only pert of its width. It has reopened for traffic until It can be closed for further snow removal, but the plowed portion has patches of snow end the edge lights on the eastern fourth of the runway are completelyobscured by snow

9-27 1/2 IN SIR PLW 100 WIDE SND 5500/75 BRAG DC9

Explanation. The center 100 ft (30 m) of a 150 ft (46 m) wide runway has been plowed its entire length but only a 75 ft. (23 m) wide stnp 5500 ft. (17 km) long has been sanded. PLW is used only if a portion of the surface has been plowed. When reporting braking action, the type of vehicle or aircraft from which the report is received should be given

APPENDIX 2 - TYPICAL SNOW PLAN

The following snow plan provides a guide for preparation of an actural plan The actual plan should be tailored to the unique requirements and conditions at the airport. See paragraph 16 for a list of items that should be considered for inclusion in a Snow Plan

MUNCHO AIRPORT

SNOW AND ICE CONTROL PLAN

1 **Responsibilities and Supervision**

a. The airport manager or his designated representative is responsible for the following (include if possible who is authorized to make decisions and their phone numbers)

(1) Determining when snow removal or anti-icing operations shall begin This will be based on the managers evaluation of existing field conditions and present and forecast weather

(2) Maintaining a constant check of runway conditions during snow or ice storms to determine presence of snow, ice, or slush and their depth and to determine the coefficient of friction by use of our qualified friction tester

(3) Keeping all NAVAID snow clearance areas within snow depth limits for the specific type of glide slope antenna configuration and notifying the local airway facilities (AF) sector office at 887-0500 immediately upon engaging the snow removal plan

(4) Disseminating airport information through the Notice to Airmen (NOTAM) system by calling 887-6532 prior to commencing snow removal or ice control operations, when low friction measurement readings are recorded, when ridges or windrows of snow remain on or adjacent to movement areas, when any hazard to aircraft operations exists, or when conditions change from those repotted by a previous NOTAM

(5) Informing the atrport traffic control tower at W-8765, air carrier operations office (United 887-6565, Delta 887-6546), and other airport users (Joe at 887-1212, etc.) of the current airport surface conditions

b All fixed-base operators will be responsible for snow removal and ice control on their designated ramp areas

c. AU supervisors (Le., Chief Maintenance Engineer) involved in snow removal and ice control are responsible for the efficient operation of snow and ice removal equipment. All equipment must be inspected by supervisors to ensure proper operation Equipment should be pmperly sheltered to ensure complete, prompt readiness for use A 72-hour supply of gasoline and diesel fuel must be kept on hand in the event that a prolonged storm occurs The equipment must be inspected for damage and/or maintenance needs after each snow and ice removal event.

2. **Vehicles**

a All snow removal and ice control vehicles operating on aircraft movement areas must be equipped with a two-way radio or be under the direct control of a vehicle so equipped Radios must be capable of monitoring the ground control frequency (or such other frequency assigned by the airport traffic control tower) at all times

b All outside contractors employed for snow and ice control operations (currently Brittany Construction) will be subject to all auport regulations They will operate under the supervision of the airport manager or his representative and get clearance from the atrport traffic control tower prior to entering movement areas At no ttme will contractors be permitted to operate equipment beyond the limits of the ramp areas without being cleared by the appropriate authorities and without being accompanied by a radio-equipped vehicle All vehicles must be equipped with the necessary lights and warning signals for night operation in accordance with AC 150/5210-5, Painting, Marking and Lighting of Vehicles Used on an Airport

c The following airport-owned equipment and authorized operators will be utilized for snow and ice control on movement areas

Vehicle No	Type	Plow	operator	Home Phone
1	4x4 Truck	14 ft Blade	J Doe	123-4567
2	4x2 Truck	Rotary	R Jones	999-0001
3	(list continues)			

Another possibility is to list personnel and equipment separately so that there is more flexibility and efficiency--this is a function of airport size and organization. Reference may be made to a list of current personnel kept in specific location at airport.

d. Brittany Construction Company is the contractor for providing equipment and trained personnel for emergency snow removal operations on an as-needed basis. Equipment available from the contractor three graders, two front-end loaders, and four 4x4 tracks equipped with 12-ft. (3 7 m) reversible plows The contractor will furnish driver/operators and all maintenance support

Contacts with Brittany Construction Company

Day 222-1492
Night 111-1895 (Sam Foreman)

Requests for contractor support must be approved by the airport manager (Jim) or his representative (operations officer)

3 Snow Removal Operations.

The following principles regarding snow removal shall be adhered to lo maintaining safe operating conditions on airport movement areas

Drifted or windrowed snow will be removed completely and promptly from runway, taxiway, and ramp surfaces.

lo the event of heavy snow accumulation, the height of snowbanks alongside usable runway, taxiway, and ramp surfaces must be such that (1) all aircraft propellers, engine pods, rotors and wingtips will clear each snowdrift and snowbank when the. aircraft's landing gear traverses any fall-strength portion of the movement area, and (2) the permissible snow heights of glide slope clearance areas are maintained

lo the event that the snow removal crew is unable to comply promptly with the requirements stated above, the airport manager or his representative will utilize the Notice to Airmen system to describe the conditions and will pmmptly notify the air carrier operations offices, airport control tower, and other airport users.

a. Snow removal operations are to commence when snow begins to accumulate on the movement surface. The runway will be closed for aircraft use if it has more than 1/2 inch (1.3 cm) of slush or 2 inches (5 1 an) of dry snow.

b The active runway, associated parallel taxiway, and taxiways connecting the active runway to the parking ramp are designated Priority 1 This will usually be the shaded areas in figure A2-1 Standard procedure will consist of·

(1) Dispatching brooms to maintain the centerline dear,

(2) Utilizing displacement plows to move the snow cast by the brooms along the edge lights, and

(3) Displacement plows will be utilized to create a windrow, and rotary plows will be utilized to cast the snow beyond the edge lights

c. Snow removal operations will commence concurrently on the Aircraft Rescue and Firefighting (ARFF) access roads and/or emergency airport access gates, the aircraft parking ramp, and the crosswind runway and its associated taxiways as shaded in figure 1 While work is progressing on these areas, the condition of the active runway will be monitored by the crew chief. If continuing snowfall requires replowing, work in all other areas will be suspended and all necessary equipment diverted to maintaining the active runway

d Maximum allowable snowbank height is defined In the graphic on the next page (Figure A2-2) and should be checked frequently by the crew chief Snowbank heights should be lower than this if possible

e. Signs and lights should be frequently checked by the crew chief for visibility and should be cleared as appropriate

f. Snow removal operations on the airport access roads, auto parking lots, and service areas will receive lowest priority The equipment dedicated to their maintenance will be used, but they will be plowed only after drivers are available Because of the importance of the safe movement of passengers and visitors on the an-port properties, access roads, parking areas, and sidewalks should be properly plowed and deiced This requires dtffereot pieces of equipment and different chemicals than used on aircraft movement surfaces and will oormaliy be the responsibility of facilities maintenance crews.

g. The glide slope snow clearance area for the "capture-effect" antenna configuration should be evaluated by the. crew chief and cleared as shown on figure A2-3 Contact should be made with the airway facilities manager or his designee at 887-6532 and the. air traffic control tower at 887-8765 before moving equipment into the ground plane area.

4 **Ice Control.** Icing conditions occur most frequently at air temperatures between 28 and 34°F (-2 and 1°C), though there have been instances as low as 5°F (-15°C) and as high as 40°F (4 4°C) Frequent contact should be made by operations staff with the National Weather Service or the contract weather service when the au temperature falls in the mmt probable icing range Runway sensors which are monitored by operations division employee3 arc important tools In determining when icing conditions may occur

a. **Runways, Taxiways** and Ramps It is the policy of this airport to apply X-7V liquid deicing chemical meeting SAE specification AMS 1426A to all priority 1 movement areas as soon as the pavement surfaces become wet and the temperature is close to 32°F (0°C) as an anti-idng treatment In the event that ice forms on movement areas, the standard procedure will be to apply prilled (solid) urea at the rate of 0 1 lb/ft^2 (49 kg/m^2) when the temperature is above 20°F (-6 7°C) and sand wetted with X-7V at temperatures below this. Absolutely no chloride salts or other corrosive chemicals are to be used on aircraft movement areas

b **Access Roads and Parking Areas.** Sodium chloride and calcium chloride are permissible on automobile roadways. Sand used in these areas may be treated with these chemicals to assist in adhering to the ice and to prevent stockpiles from freezing Bridges most receive special attention since icing frequently occurs on those surfaces prior to the adjoining pavement because of cooling from underneath.

5 **Cleanup.** AU snow windrows must be removed as soon as possible after a storm ends. Sand will be removed from runways as soon as the surface is dry and braking action has been restored The crew chief and/or operations staff will ensure that this is done 'The airfield should be checked for broken or damaged lights and signs and repairs should be made.

NOTE It is useful to append lists of personnel with their phone numbers, maps showing routing of equipment teams, radio frequencies or channels assigned to snow and ice control equipment, and other special local conditions affecting operations.

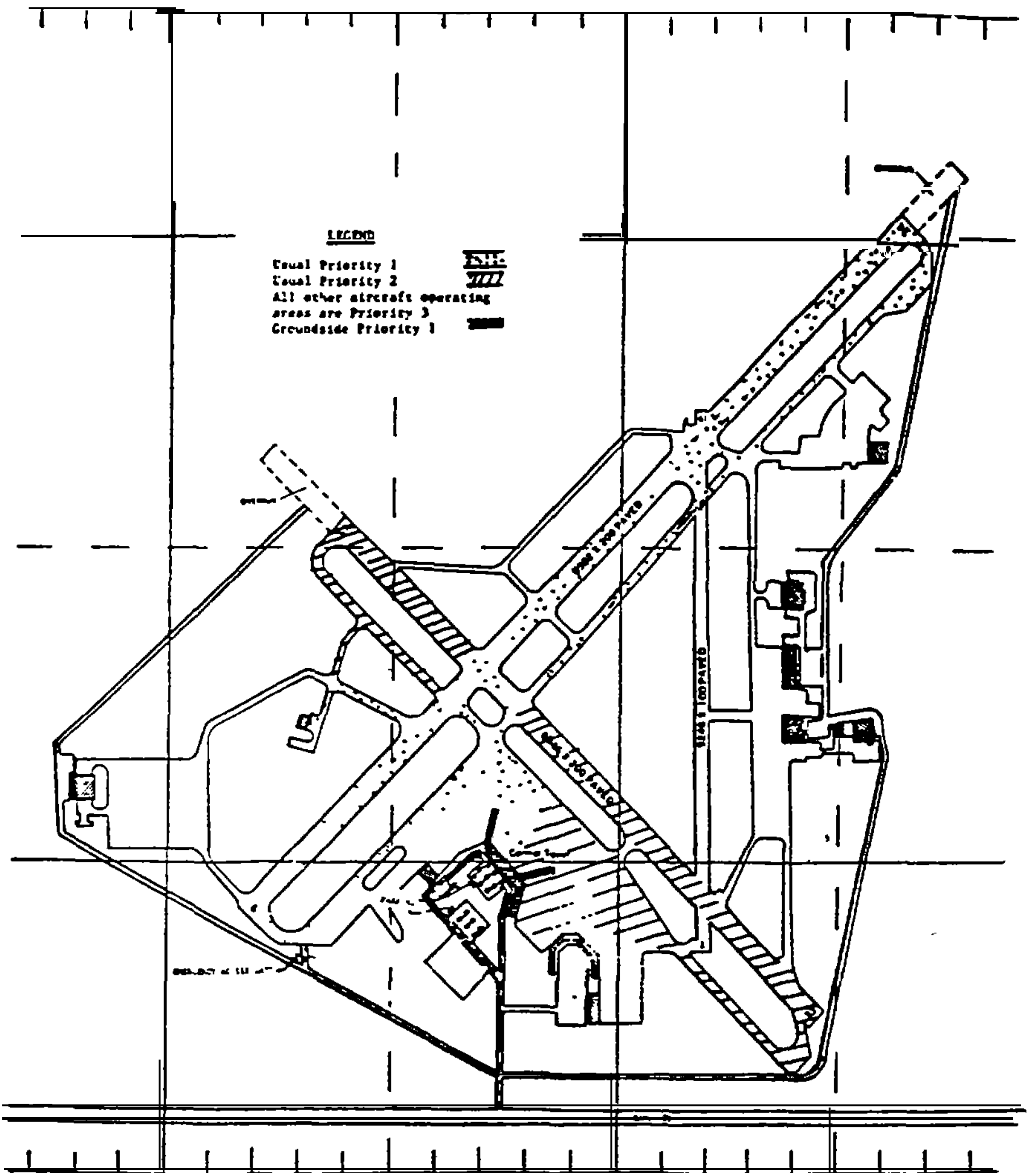
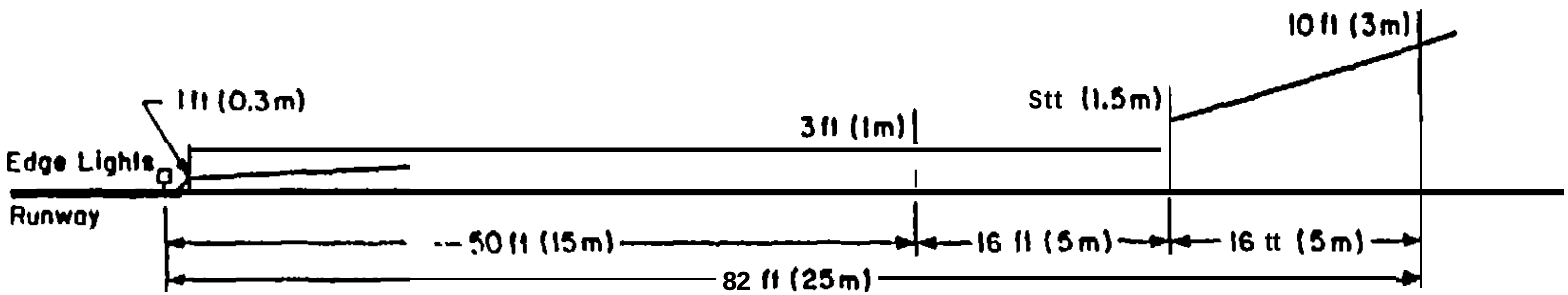
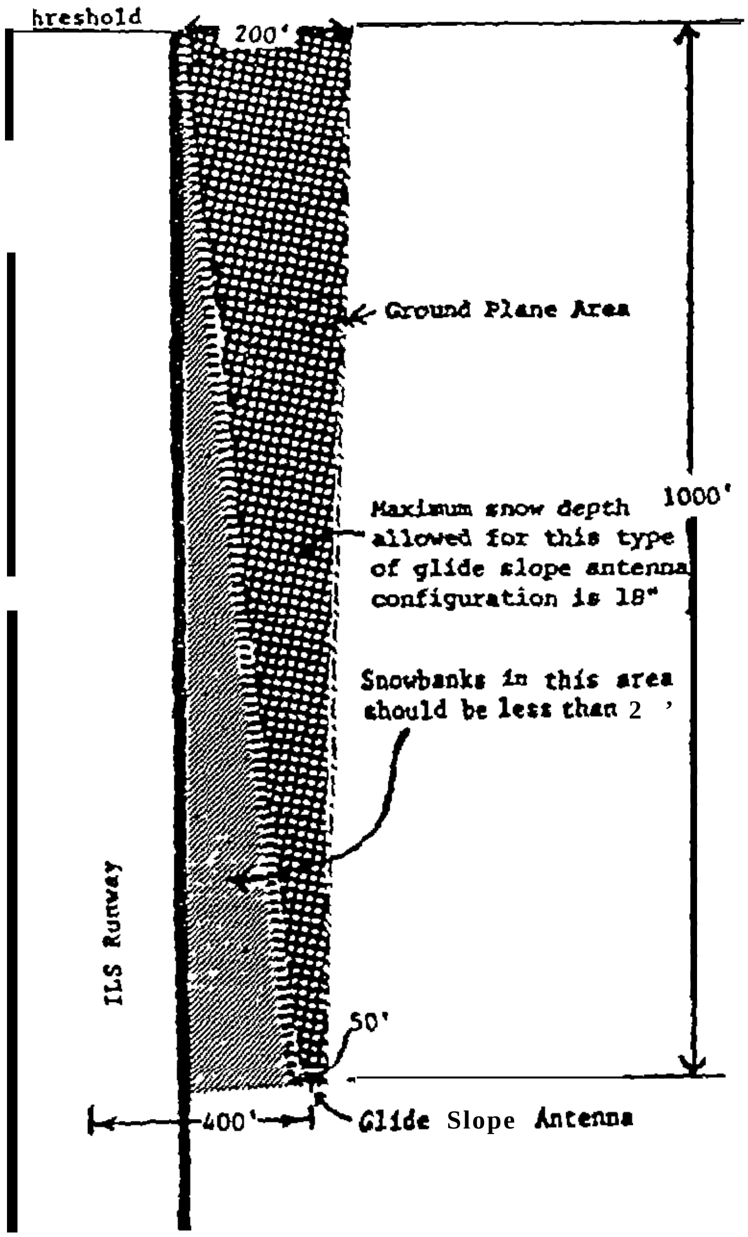


Figure AZ-1 Priority Areas for Snow Control at Muncho Airport



NOTE Figure A2-3 may take precedence near a glide slope antenna. Other glide slope antenna configurations exist that restrict the height of snow even more than this example.

Figure A2-2 Snowbank Profiles Allowed Along Runways and Taxiways



NOTE 1. A Sideband Reference GS requires less than 6 inches in the GS snow clearance area.

NOTE 2. Snowbank heights defined in figure A2-2 must also be met.

Figure A2-3 Snow Critical Areas to he Kept Clear of Snow Accumulation

APPENDIX 3 - SNOW AND ICE CONTROL AS A MATERIALS HANDLING PROBLEM

1 **Introduction.** Snow and ice have many unique properties which distinguish them from other materials commonly handled by mechanized mobile equipment. Earthmoving equipment, for example, is generally not well-adapted to handling snow because the properties of snow are so different from earth and other minerals for which this equipment was designed. Typical of these properties is its unique density, hardness, thermal instability, cohesiveness, and metamorphism (age hardening) of snow under varying winter conditions

2. **Snow** Snow is a porous, permeable aggregate of ice grams which can be predominantly single crystals or a close grouping of several crystals The pores of cold, dry snow are filled with air and water vapor In wet snow the grains are coated with liquid water

a **Density** This is the mass per unit volume, a measure of how much material there is in a given volume. Values range from very low 3 lb/ft^3 (50 kg/m^3) for low denstty, new snow) to about 37 lb/ft^3 (600 kg/m^3) Old snow which has not been compacted by vehicles or other loads normally will not exceed a density of 2.5 lb/ft^3 (400 kg/m^3) When density exceeds 50 lbs/ft^3 (800 kg/m^3), the air passages become discontinuous and the material becomes impermeable, by convention, it is called ice Uncompacted snow has little bearing capacity, so wheels readily sink into it and encounter rolling resistance. Snow increases in denstty either by deformation such as trafficking or by a natural aging process (see paragraph e below) Density is measured by weighing a sample of known volume Though earth will compact to some extent, its denstty on handling will increase only a few percent. In contrast, snow will easily increase in density over 80 percent during plowing or trafficking

b Hardness Hardness or strength depends on the grain structure and temperature. Grain structure, in turn, is dependent on the denstty of the snow and the degree of bonding between adjacent grains. Snow when it first falls is cohesionless, i.e., individual grains do not stick to one another, but bonds quickly form and grow at gram contacts As the temperature of the snow approaches the melting point, 32°F (WC), liquid water begins to coat the snow grams and though denstty remains the same, the strength will decrease Conversely, the strength or hardness will increase as temperature drops Hard snow is difficult to penetrate with a bucket or a blade plow or to disaggregate with a rotary plow Typical values for unconfined compressive strength of well-bonded snow range from less than 1 lbf/in^2 (6.89 kPa) for new snow with denstty of 62 lb/ft^3 (100 kg/m^3) to 30 lb/in^2 (207 kPa) for well-bonded snow with denstty of 25 lb/ft^3 (400 kg/m^3) Hardness is sometimes determined by measuring the resistance to penetration However, since a very good correlation exists between compressive strength and density for cold snow, determination of the density may suffice to indicate the snow hardness In contrast, the strength of dry, frozen ground is little different from thawed ground It is only when soil contains water that the strength increases upon freezing, and depending upon the ice content, it will be much like hard, compacted snow or ice in its strength

c. Thermal **Instability** Snow exists at temperatures relatively close to its melting point Most snow properties are dependent on the temperature Strength, for example, will decrease rapidly when temperature approaches 32°F (CPC) and will increase, though at a slower rate, as temperature is lowered. The thermal instability of snow is particularly important In the case of metamorphism (see paragraph e below)

d **Cohesiveness** Individual snow grams will bond to one another to form a consolidated mass Although cold, dry snow when initially deposited will tack cohesion, the age hardening process will quickly lead to bond formation and increasing cohesion (see next paragraph) Fine particles of snow produced by a rotary snowplow will adhere to each other on contact and tend to clog cutting and blowing equipment.

e **Metamorphism** Metamorphism is also called age hardening. The structure of a snow mars is continually changing by migration of water vapor from small to large grains. The number and extent of grain bonds increases with tune even in an uncompacted mass, and, as a consequence, the denstty and, hence, the strength increases The rate of change is increased when a natural snow cover is disturbed by wind drifting or by mechanical agitation such as plowing; in etther case, the snow is broken into smaller fragments, increasing the surface area and the potential for a greater number of gram contacts The increase in strength or hardness can be very rapid following plowing, particularly after blowing with a rotary snowplow Only 2 or 3 hours after plowing, snow may require three times the amount of work to reprocess it For this reason, it is advisable to clear snow to its final location as promptly as possible in order to minimize the amount of work involved

3 Ice Ordinary ice is a solid form of water consisting of a characteristic hexagonal symmetry of the water molecules Its strength and slipperiness distinguish it from snow both in the action of rubber tires trafficking a" icecovered pavement and in the effort involved in its removal

a Methods of Formation There are four common methods by which ice will form on a surface (1) radiation cooling, (2) freezing of cold rat", (3) freeze-thaw of compacted snow, and (4) freezing of ponded or melt water

(1) **Radiation Cooling** Any body will radiate energy to another body having a lower temperature Pavement exposed to the night sky will radiate energy to that nearly perfect blackbody, and if the heat is not replaced as rapidly as it is lost, cooling will result Pavement temperature can drop below freezing eve" when the air temperature is above freezing Water vapor in the air deposits on the cold surface and freezes, the rate and quantity depending on the amount of moisture in the air and the rate at which the heats of condensation and fusion of the water vapor are dissipated. The ice forms in discrete particles and may not cover the pavement completely Bonding is generally not very strong since particle contact area is small eve" when the pavement is completely covered, and therefore removal is not difficult. A ten" applied to this type of ice is surface hoar, or more commonly "hoarfrost" 0" occasion dew will form, then freeze, because of its greater area of contact, bonding will be very strong Since the layer of ice so formed will be very thin and nearly invisible, it is sometimes called "black ice" Clouds or fog will usually prevent cooling of pavement by outgoing radiation

(2) **Freezing of Cold Rain** Freezing rat" is one of the most common methods of ice formation and one of the most difficult to remove If the pavement is at or below 32°F (0°C), ram falling on it may freeze, depending on a number of factors Conditions favoring formation of so-called glare ice or glare, a homogeneous clear ice cover, are a slow rate of freezing, large droplet size, high precipitation rate, and no more than a slight degree of supercooling The ram has an opportunity to flow over the surface before freezing, forming a smooth, tightly bonded cover Glaze usually forms at air temperatures between 27 and 32°F (-3 to 0°C), though some cases have been reported as low as -5°F (-20°C) or as high as 37°F (3°C) Because of its intimate contact with the pavement, glare ice is difficult to remove by mechanical means

(3) Freeze-thaw of Compacted snow At low temperatures compaction of cold dry snow by passage of wheels will not cause a strong bond to develop between snow and pavement However, if the snow has a high water content or some melting takes place and the temperature subsequently drops, a bond as strong as that of glare ice can develop

(4) **Freezing of Ponded** or Melt Water These are commonly called icings (or "glaciers" in some regions) Though the ten" was originally limited to ice formed from groundwater flowing onto a pavement, by extension it applies to water from any source other than directly from rat'i Thus, melt water resulting from poor drainage or water impounded by snow windrows can cause icings This type of ice is usually well bonded to the pavement and, in addition, its thickness may exceed that of the other types described above This is the easiest kind of ice to avoid, proper maintenance practices will prevent accumulation of water leading to icings

b Adhesion to Surfaces The bond between ice and pavement when it is well developed will exceed the tensile strength of ice, and, therefore, when mechanical removal is attempted, failure will occur either within the ice or in the pavement "self

c Density Bubble-free ice has a density of 57 lb/ft^3 (917 kg/m^3), though by convention compacted snow which has become Impermeable (there are no connected air passages) is called ice This occurs at a density of about 50 lb/ft^3 (800 kg/m^3) Ice arising from compacted snow will not ordinarily densify beyond this value

d. Strength. Ultimate strengths of ice at 23°F (-5°C) are as follows

	kgf/cm^2	lbf/in^2
Tension	15	210
Compression	35	500
Shear	7	100
Flexure (bending)	17	240

Ice in the vicinity of the melting point has eve" lower flexural rigidity and, therefore, will not be fractured when a tire rolls over a" me-covered pavement Ice becomes bottle with increasing rigidity at low temperatures (below 20°F (-6 7°C)) The bond strength also increases as the temperature decreases

4 **Slush.** Wet snow has liquid water coating tbe grams. Wet snow is easily deformed since the grams are lubricated and slide easily past one another If the deposit is freely drained, no excess water beyond that wetting tbe surface of each gram will be. present. If, however, the snow lies on an Impermeable surface such as a pavement, water may not drain freely from It. When the amount of excess water reaches about 15 percent (I e , the amount in excess of the freely drained state), a viscous state is reached and the mass will splash and flow like a thick liquid. Upon impacting a surface, such as the landing gear or underside of an aircraft, the excess water will dram and the snow will compact and frequently bond to the surface Slush on a runway is a hazard because (1) it greatly increases drag during tbe take-off roll, (2) it reduces directional control to a great extent, and (3) it decreases braking effectiveness It can be removed by use of displacement plow which are preferably fitted with rubber or polymer cutting edges (see paragraph 23)

APPENDIX 4 - INTERIM SPECIFICATION FOR CMA/MCA

The sponsor of a certified airport may not use a CMA/MCA deicing/anti-icing chemical unless the chemical meets the interim specification of this appendix Although this appendix uses the term "vendor', the appendix does not create directly any obligations on vendors The appendix is written to assist the airport sponsor in acquiring these chemicals by providing the sponsor with specifications that can be readily attached to a procurement contract.

1 SCOPE.

1 1 Form. This interim specification covers a chemical deicing/anti-icing chemical in the form of a solid.

1 2 Application Primarily for use in deicing/anti-icing aircraft maneuvering areas, such as airport aprons, runways, and taxiways, but not aircraft.

1.3 Precautions This product is a stable, relatively nontoxic chemical as described by the Material Safety Data Sheet of paragraph 4.5 1 However, the purchaser should take necessary precautionary measures to ensure the health and safety of all personnel involved with the product For example, avoid product contact with eyes and skin and prolonged breathing of product dust.

2 APPLICABLE DOCUMENTS The below referenced publications. Aerospace Material Specifications (AMS) and the American Public Health Association (APHA), form a part of this specification to the extent specified herein The latest issues shall apply

a. AMS 1426A - Deicing/Anti-icing Fluid - Runways and Taxiways.

b AMS 1730A - Urea Product, Shotted.

c. APHA - Standard Methods for Examination of Water and Wastewater

3 TECHNICAL REQUIREMENTS

3 1 Composition The product shall be a calcium magnesium acetate product complying with the following chemical requirement. The level of soluble chloride shall be no greater than 250 ppm, determined in accordance with either Method 112A of APHA Standard Methods for Examination of Water and Wastewater or with a recognized analytical practice.

3 1 1 Moisture e reported and determined in accordance with American Society for Testing and Materials ASTM E 203

3 1 2 Insolubles Level in Aqueous Solution The level of product insolubles in a 10 percent by weight solution of product in ASTM D1193, Type IV water shall not exceed 0 S percent as determined in 3 1 2 1

3 1 2 1 Thirty grams of product diluted to 200 ml shall be freshly made, and maintained at 37°C (100°F) with agitation for 1 hour Prior to filtering, the solution should be allowed to cool to room temperature The insoluble matter shall be collected with the aid of a vacuum-filtering apparatus consisting of a water tap filter pump, a 2,000 ml Erlenmeyer flask, a size 4 (126 millimeter I.D) Buchner funnel, and a piece of 126 centimeter diameter (126 mm) Whatman No S filter paper, or equivalent. The filter paper shall be dried at 60°C (140°F) for 3 minutes in a gravity convection oven, cooled for 3 minutes in a desiccator, and weighed to the nearest 0 1 mg. The filter paper shall be placed in the Buchner funnel so that its circumference coincides with the filter paper wetted with approximately 10 cc of distilled water in order to secure it properly in place The test sample shall be rinsed with 25 cc of distilled water from a wash bottle, and the rinse transferred to the funnel, ensuring that any remaining insoluble matter is completely transferred with the rinse. When all the initial liquid and the rinse have been transferred through the filter, the sides of the funnel shall be washed with 25 cc of distilled water from a wash bottle and the rinse allowed to filter The vacuum of the flask shall be relieved and the filter paper removed from the funnel The filter paper shall be dried for 1 hour at 60°C (140°F) in a gravity convection oven, cooled for 3 minutes in a desiccator, and weighed to the nearest 0 1 mg. The percent insolubles (INS percent) shall be calculated as follows

$$\text{INS percent} = \frac{(\text{Final filter paper weight} - \text{Initial filter paper weight}) \times 100}{\text{Weight of sample}}$$

Care shall be exercised throughout the final drying and weighing cycle to maintain the flat surface of the filter paper in a horizontal position in order that no insolubles will be lost. Insoluble matter determinations shall be made on a minimum of two samples

3 2 Solid Particle Shape Report the shape of the product

3 3 Eutectic Point Shall not be higher than - 23°C (-10°F), determined In accordance with ASTM D 1177

3 4 The product shall conform to the following requirements, and performed tests shall be in accordance with specified test methods on either the product supplied or at the specified dilution concentrations of paragraph 3 4 2

3 4 1 On Concentrated Product.

3 4 1 1 Temperature Stability In accordance with AMS 1730A, paragraph 3 211

3 4 1 2 Storage Stability In accordance with AMS 1730A, paragraph 3 213, using ASTM F1104, Test Method for Preparing Aircraft Cleaning Compounds, Liquid Type, Water Base, for Storage Stability Testing.

3 4 2 On Diluted Product Performed test shall be at dilutions of both 5 percent and 15 percent concentrations, unless otherwise specified In ASTM D1193, Type IV water

3 4 2 1 pH of Aqueous Solution A 15 percent by weight solution of the product in ASTM D1193, Type IV water shall exhibit a pH in the range 7 0 - 9 5, determined In accordance with ASTM E70

3 4 2 2 Residue In accordance with AMS 1730A, paragraph 3221.1, except substitute "water ASTM D1193, Type IV for "methyl ethyl ketone" as the rinsing agent.

3 4 2 3 Effect on Painted and Unpainted Surfaces In accordance with AMS 1426A, paragraphs 3 28 and 3 29

3 4 2 4 Effect on Transparent Plastics In accordance with AMS 1730A, paragraph 3 224

3 4 2 5 Corrosion of Metal Surfaces In accordance with all three subparagraphs of AMS 1426A, paragraph 3 25, with subparagraph 3 25 1, limited to a rating not worse than 2 in accordance with ASTM F1110, Standard Test Method for Sandwich Corrosion Test, and subparagraph 3 25 3 determined in accordance with ASTM F1111, Corrosion of Low-Embrittling Cadmium Plate by Aircraft Maintenance Chemicals

3 4 2 6 Hydrogen Embrittlement. In accordance with AMS 1730A, paragraph 3 223.

3 4 2 7 Stress-Corrosion Resistance of Titanium Alloys In accordance with ASTM F945, Method A.

3 4 3 Pavement Compatibility

3 4 3 1 Scaling Resistance In accordance with AMS 1426A, paragraph 3 2111, except that a 20 percent by weight solution of the deicer/anti-icer in tap water, shall be substituted for calcium chloride (section 7 1 of ASTM C672)

3 4 4 Performance The product, used in accordance with manufacturer's recommendations, shall prevent ice formation (anti-icing) and remove normally accumulated deposits of frost and ice (deicing) from aircraft maneuvering areas

3 4 5 Quality Product, as received by purchaser, shall be uniform, uncoated, and free from foreign materials detrimental to usage of the product

4 QUALITY ASSURANCE PROVISIONS

4 1 Responsibility for Inspection The vendor of the product shall supply all samples for vendor's tests and shall be responsible for performing all required tests Results of such tests shall be reported to the purchaser as required by section 4.5 Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the product conforms to the requirements of this interim specification

4 2 Classification of Tests

4 2 1 Acceptance Tests Tests to determine conformance to requirements for composition (3 1), pH (3 4 2.1), total immersion test of only AMS 4049 aluminum alloy - corrosion of metal surfaces (3 4 2.5), hydrogen embrittlement (3 4 2.6), and effect on transparent plastics (3 4 2.4), are classified as acceptance tests and shall be performed on each lot.

4 2 2 Periodic Tests Tests to determine conformance to requirements for eutectic point (3 3), temperature stability (3 4 1 1), effect on painted and unpainted surfaces (3 4 2.3), residue (3 4.2 2), corrosion of metal surfaces except the total immersion test for AMS 4049 aluminum alloy (3 4 2.5), scaling resistance (3 4 3 1), stress-corrosion resistance of titanium alloys (3 4 2.7), and delivery containers (5 2 1) are classified as periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser In all cases, periodic tests must be performed at least once every 3 years

4 2 3 Preproduction Tests Tests to determine conformance to all technical requirements of this specification are classified as preproduction tests and shall be performed prior to or on the initial shipment of the product to a purchaser, when a change in ingredients, processing, or both requires reapproval as in 44.2, and when purchaser deems confirmatory testing to be required

43 **Sampling** Shall be in accordance with all applicable requirements of ASTM D1568 and Military Standard MIL-STD-105, Level S-2 A lot shall consist of all the product produced in one continuous manufacturing operation from the same lots of raw materials and presented for vendor's inspection at one time. In the event the process is a batch operation (see 43 1), each batch shall constitute a lot.

431 A batch is defined as the quantity of materials which has been manufactured by some unit chemical process or subjected to some physical mixing operation intended to make the final product substantially uniform.

432 When a statistical sampling plan and acceptance quality level (AQL) have been agreed upon by purchaser and vendors, sampling shall be in accordance with such plan in lieu of sampling as in 4.3, and the report specified in 4 5 shall state that such plan was used.

44 **Approval**

441 Sample product shall be approved by purchaser before the product for production use is supplied, unless such approval is waived by purchaser Results of tests on product production shall be essentially equivalent to those on the approved sample.

442 Vendor shall use ingredients, manufacturing procedures, and methods of inspection on production product which are essentially the same as those used on the approved sample product If necessary to make any change in ingredients or in manufacturing procedures, vendor shall submit for reapproval a statement of the proposed changes in materials processing, or both and, when requested, product sample. Production product made by the revised procedure shall not be shipped prior to receipt of reapproval.

45 **Reports** The vendor of the produa shall furnish with each shipment a report certifying the results of tests to determine conformance to the acceptance test requirements and, when performed, to the periodic teat requirements and stating that the product conforms to the other technical requirements of this specification This report shall Include the purchase. order number, manufacturer's identification, lot number, quantity, and product designation (CMA or MCA)

451 **Material Safety Data Sheet** A material safety data sheet (MSDS) conforming to AMS 2825, Mat&al Safety Data Sheet,or equivalent, shall be supplied to each purchaser prior to, or concurrent with, the report of preproduction test results or if preproduction testing is waived by purchaser, concurrent with the first shipment of product for production use Each request for modification of produa formulation shall be accompanied by a revised data sheet for the proposed formulation.

46 **Resampling and Retesting** If any sample used in the above tests fails to meet the specified requirements, disposition of the product may be based on the results of testing three additional samples for each original nonconforming sample Failure of any retest sample to meet the specified requirements shall be cause for rejection of the product represented and no additional testing shall be permitted. Results of all tests shall be reported

5 PREPARATION FOR DELIVERY

51 **Identification** Each container shall be legibly marked with not less than vendor's identification, purchase order number, lot or batch number, quantity, and product designation (CMA or MCA)

52 **Packaging**

5.21 The product shall be packed in containers of a type and size agreed upon by purchaser and vendor or delivered in bulk Containers used for delivery to purchaser shall be thoroughly cleaned and emptied of any foreign particles or materials

5 2.2 Containers of the product shall be prepared for shipment in accordance with commercial practice and in compliance with applicable rules and regulations pertaining to the handling, packing, and transportation of the product to ensure carrier acceptance and safe delivery Packing shall conform to carrier rules and regulations applicable to the mode of transportation

6 ACKNOWLEDGMENT A vendor shall mention this advisory circular, and appendix 4, in all quotations and when acknowledging purchase orders

7 REJECTIONS Product not conforming to this interim specification or to modifications authorized by purchaser will be subject to rejection

8 DIMENSIONS AND PROPERTIES Inch/pound units and the Celsius temperatures are primary units. For information, SI units and the Fahrenheit temperatures are approximate equivalents of the primary units.

APPENDIX 5 - FAA-APPROVED MANUFACTURERS OF FRICTION EQUIPMENT

CONTINUOUS FRICTION MEASURING EQUIPMENT

MANUFACTURER/SALES REPRESENTATIVE
K. J. LAW ENGINEERS, INC. President Transportation Testing Equipment Division 42300 West Nine Mile Road Novi, Michigan 48375-4103 FAX (313) 347-3343 (M 6800) (313) 347-3300 RUNWAY FRICTION TESTER
BISON INSTRUMENTS, INC. President 5708 West 36th Street Minneapolis, Minnesota 55416 FAX (612) 926-0745 (612) 926-1846 MU METER (Hark 4)
AIRPORT EQUIPMENT COMPANY AB President- (H) 46 (758) 51589 Post Office Box 20079 BROMMA, SWEDEN S-161 20 (8)-29 5070 (0) SKIDDOMETER (BV-11)
AIRPORT TECHNOLOGY USA President 6 Landmark Square Suite 400 Stamford, Connecticut 06901 FAX (203) 378-0501 (Mark 2) (203) 359-5730 SURFACE FRICTION TESTER

DECELEROMETER FRICTION EQUIPMENT

MANUFACTURER/SALES REPRESENTATIVE
BOWMONK SALES President 50 Tiffield Road UNIT #10 Scarborough, Ontario CANADA M1V 5B7 FAX (416) 609-0827 (416) 609-0858 BOWMONK DECELEROMETER
TAPLEY SALES (CANADA) President 100 Palmer Circle R.R. No. 2 Bolton, Ontario CANADA L7E 5R8 FAX (416) 231-9121 (416) 880-0858 TAPLEY DECELEROMETER

APPENDIX 6 - PERFORMANCE STANDARDS FOR DECELEROMETERS

1 **Scope.** This appendix describes the procedures for establishing the reliability, performance, and consistency of decelerometers

2 **Certification (General)** The manufacturer will certify that the electronic or mechanical decelerometers

a. Are portable, rugged, and reliable.

b Are capable of being fitted to vehicles qualified by the requirements given in this specification Minimal vehicle modifications will be necessary to accommodate the mounting plates and electrical connections. Vehicles are qualified according to their size, braking and suspension system, shock absorber capabilities, and tire performance The vehicle shall

(1) Be either large sedans, station wagons, intermediate or full size automobiles, or utility and passenger-cargo trucks Vehicles can be powered by either front-wheel, rear-wheel, or four-wheel drive

(2) Be equipped with either standard disc and/or drum brakes as long as they are maintained according to the manufacturer's performance requirements They can also qualify if they have a single sensor ABS (anti-lock braking system) installed on the rear axle

(3) Be equipped with heavyduty suspension and shock absorbers to minimize the rocking or pitching motion during the application of brakes The weight should be distributed equally to the front and rear axle of the vehicle Ballast can be added to achieve and maintain this distribution.

(4) Have tires made from the same construction, composition, and tread configuration Inflation pressure shall be maintained according to the vehicle manufacturer's specifications When tread wear is excessive on any one tire on the vehicle and/or exceeds 75 percent of the original tread, all four tires on the vehicle shall be replaced with new tires

c. Shall be capable of measuring the deceleration of the vehicle from speeds greater than or equal to 15 mph (24 km/h) to an accuracy of $\pm$ 0 02 g

d Shall be capable of providing deceleration values upon request of the operator

e Shall be capable of consistently repeating friction averages throughout the friction range on all types of compacted snow and/or ice-covered runway pavement surfaces.

f Shall not be affected by changes in vehicle velocity

g Shall not be affected by change in personnel or their performance in brake-applied decelerations

h Shall be capable of providing the vehicle operator with a readily visible deceleration reading

i. Shall be capable of providing the deceleration values in recorded order enabling the average friction value for any length of runway to be either electronically or manually calculated.

j Shall be capable of providing average deceleration values for touchdown, midpoint, and rollout zones of the runway and the average friction value for the entire runway tested These averages shall be automatically calculated by the decelerometers, thus eliminating potential human error when calculated manually

3 **Certification (electronic only)** The manufacturer will certify that the electronic decelerometer

a Shall be capable of storing a minimum of 21 deceleration values via the internal microprocessor memory

b Shall be capable of providing a hard copy printout of stored deceleration values at the end of the testing period. The printout will record a minimum of

(1) Providing the date

(2) Providing the tune

(3) Providing the runway designation or heading

c. Shall be capable of providing further information, which may be recorded at the manufacturers discretion, e.g., make of decelerometer, ambient/pavement temperature, airport name and location, and operator identification.

4 **Decelerometer Calibration.** The decelerometer shall be calibrated by the manufacturer before shipping to the airport authority The manufacturer shall provide the airport authority with a certificate of calibration, including test results of the calibration. The manufacturer shall provide a 1 year warranty for the decelerometer.

The decelerometer shall be returned to the manufacturer for servicing and recalibration every 2 years.

5 **Training.** The manufacturer shall provide the airport authority with training manuals and/or videos of all relevant data concerning friction measuring recording and reporting, including

a. An outline of the principles involved in the operation of the decelerometer-type friction measuring device.

b. Copies of pertinent advisory circulars

c. Procedures for reporting results of the friction tests in NOTAM format.

AIRPORT NAME ____________________________

DATE OF SURVEY	TIME	RUNWAY-TAXIWAY DESIGNATOR	DESCRIPTION OF SURFACE CONDITION	CONTAMINANT REMOVAL		TEMPERATURE	
				METHOD(S) EMPLOYED	TIME	AMBIENT	PAVEMENT

TYPE OF FRICTION MEASURING DEVICE USED AT AIRPORT	DATE LAST CALIBRATED	VEHICLE SPEED (MPH)	LOCATION OF TEST RUN FROM RUNWAY CENTERLINE (FEET)	AVERAGED MU NUMBERS--EACH ZONE			REMARKS
				TOUCHDOWN ZONE	MIDPOINT ZONE	ROLLOUT ZONE	

Figure 2-1 Runway Friction Survey Record

16 CLEARANCE PRIORITIES Since all aircraft movement surfaces cannot be cleared simultaneously, the most critical areas should be attended to first with other areas taken care of in then order of importance Airport operators should identify and prioritize all areas to be cleared of snow and ice based on safety requirements, flight schedules, and operational routes of traffic Priority 1 areas normally include the primary instrument runway, its principal taxiways and high-speed turnoffs, designated ramp areas, emergency roads or firefighters' access routes, and NAVAID's (see subparagraph 10g) for the active instrument runway(s) Priority 2 areas generally include secondary runways and taxiways, other NAVAID's, and ramp areas not otherwise classified Priority 3 areas may include refueling areas and perimeter roads The face of all signs and all runway lights should be kept clear of snow at all times, and they should be checked frequently during the snow removal operation to ensure that they are both cleared of snow and operational Roads to the passenger terminal should be considered in a separate category since different equipment and techniques may be employed and timely access and departure by the public rather than operational safety is the objective

17 CLEARANCE TIMES. The number of pieces of equipment normally required to accomplish the clearance priorities outlined in paragraph 16 can be determined based on individual equipment performance specifications For example, the speed of operation of a snow removal team is generally controlled by the capacity and speed of the rotary plows assigned to it Once the number and type of rotary plows are determined, the number of displacement plows, brooms, etc , can be determined

a Commercial Service Airports Commercial service airports should have sufficient equipment to clear 1 inch (254 cm) of snow weighing up to 25 lb/ft^3 (400 kg/m^3) from the primary instrument runway, one or two principal taxiways to the ramp area, emergency or firefighters' access roads, and sufficient ramp area to accommodate anticipated aircraft operations within the times shown below If parallel runways typically have simultaneous operations during the winter months, the areas for both runways and associated principal taxiways should be included

Annual operations	Clearance time (hour)
40,000 or more	1/2
10,000-40,000	1
6,000-10,000	1-1/2
6,000 or less	2

b Other than Commercial Service Airports All other airports should have sufficient equipment to clear I inch (254 cm) of snow weighing up to 25 lb/ft^3 (400 kg/m^3) from the primary instrument runway or that runway providing the maximum wind coverage, the principal taxiway to the ramp area, and sufficient ramp area to accommodate anticipated aircraft operations within the times shown below

Annual operations	Clearance time hour)
40,000 or more	2
10,000-40,000	3
6,000-10,000	4
6,000 or less	6

18 STORAGE OF ICE CONTROL MATERIALS Enclosed shelters are recommended for storing ice control materials Storage of deicing/anti-icing chemicals reduces the prospect of product degradation due to environmental effects while storage of abrasives reduces the potential for leaching of chemicals that lower the abrasive's freezing point Storage prevents absorption of moisture which "my freeze the stockpile during cold weather Storage also permits preheating a" abrasive prior to application AC 150/5220-18, Buildings for Storage and Maintenance of Airport Snow and Ice Control Equipment and Materials, provides typical layouts and other recommendations for the storage of ice control materials

19 EQUIPMENT MAINTENANCE AND STORAGE Whenever possible, snow and ice control equipment should be housed in heated garages during the winter to prolong the useful life of the equipment and to enable rapid response to operational needs Repair facilities should be available for onsite equipment maintenance and repair during the winter season Equipment should be inspected after each use to determine whether additional maintenance or repair is appropriate AC 150/5220-18 provides typical layouts and other recommendations for the storage of equipment

20 RESERVED

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**Federal Aviation
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